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UNIV.
OF
MICH.

REPORT

OF

B. AYCRIGG, PRINCIPAL ENGINEER

OF THE COUNTRY FOR THE IMPROVEMENTS

ON THE

WEST BRANCH,

TO THE TOWN OF FRANKLIN, IN VENANGO CO.,

Read March 1, 1837.

HARRISBURG:
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REPORT, &c.

CANAL COMMISSIONER'S ROOM.

March 1, 1837.

JOSEPH RITNER,

Governor of Pennsylvania.

SIR :—By direction of the board, I herewith transmit to you a duplicate of the final report and estimates and the survey of a canal route between the West Branch improvements and the town of Franklin, on the Allegheny river, by B. Aycrigg, Principal Engineer, with a view to their being laid before the legislature.

Very respectfully,
MOSES SULLIVAN, *President,*

Harrisburg, February, 1837.

TO MOSES SULLIVAN ESQ.

President of the Board of Canal Commissioners of Pennsylvania.

SIR :—In the partial report made to the board on the 13th December last, there was given a general view of the result of the examination to ascertain the best mode of connecting the improvements on the West Branch, with those on the Allegheny; whether by canal, slackwater or rail-road. An entire water communication was there shown to be practicable upon the ground, that the valley of Sandy Lick creek might be converted into a reservoir, capable when once filled, of supplying more water than could be used in one season. That one fourth of the smallest amount that has fallen annually in Lebanon, during the last seven years, when collected from the basin immediately surrounding the reservoir, and containing an area of eighty square miles, will be sufficient to fill its depth of twenty feet over an average area of three square miles, while we can also command the drainage from twenty additional square miles, on the eastern side of the dividing ridge. And finally, to remove all doubts from the minds of the most incredulous, we can procure the whole of the water of Little Toby.

But since doubts may exist in the minds of some who do not feel sufficiently acquainted with the subject to decide for themselves, but depend upon the reports of those who have made this business their study, and therefore hesitate between the apparently conflicting opinions of different engineers, one stating that a water communication is practicable, and another that it is not, it is proper to call attention to the fact that there is no such conflicting opinion.

Had it been proposed to feed the canal in this neighbourhood by a dam constructed half way across the Susquehanna, we might have placed every confidence in the report of the engineer, and granted it to be a fact that nothing better could be done, but we should not have required his opinion to have at once decided that it would answer no useful purpose. But should a subsequent examination prove that this dam might be extended across the river, the question would then assume an entirely different appearance.

As to the point at issue: Had the former report merely stated in general terms, that a water communication was impracticable, the assertions might differ, either with or without there being a difference of opinion, and we should be at loss to know what was the real state of the case. But in this instance we are not left in doubt, for we have the premises from which the former conclusions were drawn and being in posession of these, we have sufficient grounds for pronouncing them undoubtedly correct as far as they go. If nothing more could be done than was formerly proposed, it would be useless to agitate the question, and we might fold our arms quietly and see other states extending their water communications to the west, without being able to compete with them by a similar improvement.

The defect in the former examination was not its inaccuracy, for we found all the facts as stated, but its deficiency in stopping short of the mark and omitting that which was of most consequence without noticing other less important differences. In 1827, it was proposed to construct a reservoir four feet deep, and covering an area of two hundred and fifty acres. In 1836, it is proposed to extend this reservoir to forty times the former size, or twenty feet effective depth, with a full area of over two thousand acres. The communication was impracticable according to the plan of 1827, but the difficulty vanishes in 1836. There is no difference of opinion, for no opinion was ever given before upon the proposed plan, and the whole question now stands alone as much as if there never had been a previous examination of the country. The facts are as stated, and it requires no abstruse scientific investigation, to draw the conclusion that a water communication is undoubtedly practicable. It is a plain common sense matter, that any man can comprehend who will take the time to examine for himself. The calculations of the supply of water are contained in the former report.

It is worthy of notice that this is but one of the four routes that have been examined before last season, and that there has been but one report fomerly made upon this section. The rest having no bearing on the present question.

With respect to the estimate, the same work may be made to appear very differently by supposing every thing favorable and prices low, by taking average work and prices, or by supposing every thing adverse. It therefore becomes an important part of every estimate to have it distinctly stated which of the three it is intended for, whether the least possible, the propable or the greatest that can be expected. In accordance with this view, the following estimate is given as the ultimate expense of the improvement according to the line as actually run and laid out on the ground, without subtracting any thing for changes, that during the examinations appeared reasonable, and likely to reduce the expense, since the object kept in view was to get over as much of the distance as was possible, taking time only to examine one single arrangement of the line, and ascertain its expense, leaving it for future consideration to alter and amend the plan so as to fit it more exactly to the country and consequently reduce the cost.

When different plans of improvement suggested themselves, the question was settled by estimating the most expensive; side hills were supposed to be solid rock, and the banks supposed to be thrown entirely in the beds of the creeks, and the principle of over estimating carried throughout.

In laying out and constructing the canal these would be reversed. Time would be taken at each point to decide the best manner of improving that particular place. No side hill would be avoided unless counteracted by disadvantages in the use of the canal. The prices on the average probably less than those which have been asumed, and from all these circumstances taken together, and a proper economy in adapting the work to the end proposed without useless expense, for the purpose of display, there is little doubt but that the cost will be less than the estimate. But as a matter of security, the question should be met upon the grounds of the whole of the amount being required. The estimate for the main tunnel on the summit is made upon the supposition that it may be necessary to carry in the deep cuts until the rock reaches the height of forty feet above the bottom of the canal. This would be more expensive than tunnelling, but is in accordance with the general principle of overestimating as before mentioned. The distance between these points, we found by sounding, to be one mile or as near as may be, and one mile is therefore taken as the length of the tunnel. It is also presumed from the general character of the rock in that section of the country that the roof will support itself; but the estimate is made upon the supposition that the excavation be made large enough to admit a wall and arch, should they at any future time be found necessary. The excavation is taken at twenty-five feet wide from the height of the towpath to the springing lines of the arc of excavation, at fourteen feet above the bottom, and the centre made semicircular. The water way to be seventeen feet wide and five feet deep, and width above towpath twenty-one feet when walled.

With one tunnel of this description, a mile long, the boats would be obliged to wait for certain hours and pass in fleets; but when this becomes a serious difficulty from the increase of trade, a similar and parallel tunnel should be constructed during the winter, and might be carried on with any desired expedition. The first tunnel answering the purpose of a drift to work the second throughout its whole extent, and drain off the water and thus make the second much less expensive than the first, while the side drifts used in the excavation, would leave a free passage for the water from one tunnel to the other.

The advantage of having two small, in place of one large tunnel are diminished expense in excavation, the convenience that in case one should be accidentially obstructed, the other might be used until it was cleared, but principally the greater security of a small tunnel in supporting the superincumbent weight.

It will be observed that no estimate has been made of that part of the line included between the head of the West Branch improvements and the mouth of Sinnemahoning, nor of that part along the Allegheny. The work of last season having been limited by the mouth of Red bank on the Allegheny, and the mouth of Sinnemahoning, on the West Branch. But from Mr. Wilson's notes, it appears that the distance from the latter point to the Tangascootac, the present head of the West Branch improvements is 30½ miles, and descent 128 feet.

The distance from the mouth of Red Bank to Franklin, would be about sixty miles, after cutting off five miles at the great bend above Red Bank by a tunnel of about one fourth of a mile. From Red Bank to the Western canal at the mouth of Kiskiminetas is thirty-six miles. This being the extra distance to complete the line to Pittsburg, making the distance from this place to Pittsburg by way of the West Branch and Allegheny canal sixty-five miles further than by the Portage rail-road.

The accompanying abstract and more concise tabular statement, contain the estimated expense of every item of work occurring within the limits of each mile of the canal, from the mouth of the Red Bank, to the mouth of Sinnemahoning. They are prepared from a volume intended to be deposited in the office, for the use of the engineer who may hereafter have charge of the work, in order to aid him in his examination, by giving a general view of the ground from what has already been done. The miles are numbered each way from the dam at the western end of the reservoir, those on the side towards the Allegheny, being denominated the western, and those towards the West Branch (including the reservoir and tunnel) the Eastern division.

The maps and profiles that should properly accompany the report are not yet finished, but will be returned to the board as soon as they can be prepared.

It will be observed that every item of work that will be necessary *to put the canal in* complete navigable order, including lock houses, farm and road bridges, fences, repairing roads where they are injured, &c., are all included in the estimate. All that remains will be the cost of superintendence and a small amount of damages. With respect to the mills along the creeks, care was taken so to arrange the line as not to interfere with the water power, if it could be avoided, which was the case with one trifling exception. In place of estimating a bill of damages for the mill owners, the increased cost of the canal has been calculated so as to leave their works undisturbed.

The estimate has likewise been made upon the supposition of having the locks constructed of cut stone, the whole improvement to be a perfect work, no expense spared to render it useful and substantial, but not a dollar for mere looks. The cost has been increased by shortening the distance at the following points.

On the West	at Potter's,	90	chains by a	throuogh-cut.
”	at Barr's,	76	” ”	tunnel 9 chains.
”	at Brookville,	120	” ”	15 ”
”	at Knabb's,	118	” ”	11,7 ”
”	at Robinson's,	101	” ”	thorough-cut.
”	at Great Bend,	343	” ”	tunnel. 17,67.
		848	chains, distance cut off on West.	

On the East the distance is reduced.

At Weed's,	40	chains, by	changing bed of creek.
At Warner's,	48	”	thorough-cut.
	88	chains.	

Making the total amount of reduction nine hundred and thirty-six chains, or eleven miles and fifty six chains, leaving the total length of the canal from river to river one hundred and twenty-six and a half miles. The importance of this arrangement is not generally considered. For the purpose of calculation we will suppose but half the trade that was assumed in estimating the amount of water that would be required on the summit, or that boats will pass every six minutes, for eight months or two hundred and forty days, that each boat costs three dollars and sixty cents per day, and travels twenty-four miles, (if relays of men and horses are used the expense must be increased in proportion,) making the cost for each boat fifteen cents per mile, or for all the boats in one day for each mile thirty-six dollars, making in two hundred and forty days eight thousand six hundred and forty dollars, the interest of one hundred and forty-four thousand dollars at six per cent. Consequently if the trade be as great as supposed an increased expense of one hundred and forty-four thousand dollars, to cut off one mile in distance will be repaid by the perpetual saving of the industry of the country, to an amount equal to the interest of that sum. The annual expense of keeping the line in order would likewise be reduced in proportion to the distance.

If the objection be raised, that the state has no interest in reducing the length, especially at an increased expense, since boats pay by the mile, the argument in its favour is supported by granting an increased toll per mile, to compensate the state for the increased expense in the construction.

In an other point of view: This work is generally considered a competitor with others for the western trade. If this be the case, then every advantage that can be given to the transporter, will be so much gained in comparison with rival improvements. But the immense western country, that is but beginning to develope its resources will probably ere this work can be finished, quiet all thoughts of rivalry and demand within a few years, increased facilities that would now appear visionary to most persons.

But although according to the above supposition there would be an advantage of one hundred and forty-four thousand dollars, in reducing the line one mile, still this requires a heavy trade and has not been carried to the same extent in laying ont the line. The above calculation was merely introduced to illustrate the principle. The additional cost on the present line, incurred by going through rather than around the hills, is not known as the levels were not taken around the points, but it will in no case exceed one tenth of the proportion above, while in others it will reduce the total cost although the expense per mile will be greater. For convenience of reference the total amount of the different kinds of work together with their total cost and average price, are given below as it may be satisfactory to have them to compare with the actual prices heretofore paid, as shown in the reports.

These items are as follows, viz:

				Average price.
529,741.64	cubic yds.	common excavation,	$52,974 10	10.00 cts.
841,387.46	"	difficult, "	146,578 72	17.42
1,927,818.06	"	common embankm't,	240,851 20	12.49
3,951,441.94	"	difficult,	627,076 36	15.87
629,556.20	"	rock,	296,040 90	47.62
327,112.90	"	wall,	191,191 63	15.00
24,924.65	"	wall foundation,	8,684 50	34.80
3,879.00	feet	length of dams,	417,527 89	$34 48 per foot
861.60	chains	of tow-path,	29,708 50	
182		locks, } average lift 7.02 feet,	976,900	5,367 58 each.
1,278	feet	lift		764.397 per ft.lift.
10		reservoir, locks,	75,576 08	7,557 61 each.
5,280	feet	main tunnel,	250,000	47 35 per ft.
3,522	feet	sum of four short tunnels,		
		Union canal tunnel 18 feet wide, cost		27 66 per ft.

Cutting off points,	133,425		37.882	per ft.*
Puddle ditch,	20,640			
Grubbing and clearing,	54,700			
Lock houses,	58,100		350	each.
Aqueducts,	52,716	84		
Culverts,	21,360			
Tow-path bridges,	14,221			
Road and farm bridges,	61,900			
Making and reparing road,	5,476	28		
Making fences,	8,328			
Waste Weirs,	23,400			
	$3,767,377			
Add for contingencies 5 per cent,	188,368	85		
Making the total,	$3,955,745	85		

This amount of $3,955,745 85 resulting from the addition of innumerable sums, calculated from notes taken during the examination is the total amount that will be required to connect the West Branch with the Allegheny. It is given as the estimate not of the probable but of the greatest expense, and it is believed that should the work be properly constructed a considerable surplus will be left. The same principle has been followed, as in the course of ten years practice has been used by the undersigned in estimating several other works, (small it is true in comparison with the present,) but in no instance has the expense of construction exceeded the amount of the estimate.

Before taking leave of this subject, I would respectfully suggest, the plan that appears best to effect the completion of this work in the time and with the smallest loss of interest. Whenever the conclusion shall be officially made that the interests of the state demands the connexion of the east with the west, by means of a water communication, the most advisable plan would be to have the work so arranged that it would be all completed and ready for use about the same time. It is supposed that it will require five years to finish the tunnel and deep cuts at each side, or two years longer than any other part of the work, and therefore that they should be commenced that length of time in advance of the rest. During the third year the second grade of difficult work might be put under contract, leaving it for the fourth and fith year to prosecute the balance with all the power that would be necessary to finish it in time to meet that which was first begun.

The deep cuts should be excavated for the purpose of draining the water from the tunnel, while the miners are engaged in excavation it. The expense of this part would be the following, viz:

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*Union canal tunnel eighteen feet wide, cost $27 66 per foot.